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(54) Title: COATING FOR PAPERBOARD

(57) Abstract

Paperboard is coated with a coating containing one or more triglycerides. The coating may also contain a plasticizer. Although the coated paperboard takes up significant amounts of water in humid or cool room conditions, the paperboard exhibits good wet strength properties. The coated paperboard is especially useful to produce boxes.

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TITLE: COATING FOR PAPERBOARD

The present invention relates to a coated paperboard, to products, especially containers and blanks therefor, made from coated paperboard and to a method of applying a coating to paperboard.

Paper and paperboard are widely used in the manufacture of containers, such as boxes, for storage and transport of produce. For convenience, the word "paperboard" will be used hereinafter to denote both paper and paperboard that is suitable for the manufacture of boxes and other containers. The term "boxboard" will also be used to denote a material that is used in the manufacture of boxes, such as cardboard boxes. Although generally possessing satisfactory properties for the manufacture and use of such containers, paperboard will absorb moisture if the container is exposed to a wet or humid environment. Moisture exposure may result from the weather, by splashing of the container, by storage in a high humidity environment, by emission of moisture from product stored in the container (e.g. fruit and vegetables) or by breakage of produce inside the container. Once the paperboard has absorbed moisture, its strength decreases quite dramatically.

This problem is particularly acute in respect of produce boxes destined for storage of produce (possible for many days or weeks) in cool rooms. Humidity levels in cool rooms can approach 100%, which leads to relatively high levels of moisture absorption in untreated paperboard containers.

To overcome this problem, a number of treatments have been proposed to attempt to increase the water resistance of the paperboard. These treatments include a variety of polymer coatings that are applied to the paperboard. Commercially, the most common treatment involves applying a wax coating to the paperboard. The wax, which is a petroleum-based product having a mixture of long chain molecules, is applied by passing the paperboard through a bath of molten wax or under a shower of molten wax. The molten wax penetrates into the paperboard and forms a layer on top of the paperboard. If corrugated paperboard, which consists of a corrugated layer sandwiched between two facing sheets, is used, the coating treatment generally results in both the corrugated layers and the facing sheets becoming coated with wax.

The purpose of applying the wax is to give the paperboard sufficient strength under wet conditions that would otherwise lead to softening of untreated paperboard and consequent collapse under moderate compression load. The wax acts as a water resistant layer to decrease water permeability into the paperboard. The wax coating also has a strength associated with it and this also adds to the strength of the paperboard. Wax levels currently used to coat paperboard destined for storage and transport containers typically result in the wax comprising from 50 to 60% of final container weight, with wax thickness of from 0.05 to 0.1 mm on exposed faces of the container and much thicker elsewhere.

Although wax coatings allow the manufacture of paperboard containers to have acceptable performance under humid and cool room conditions, it has been found that wax–coated containers are difficult to recycle. It will be appreciated that there is a worldwide trend to increase the amount of recycled paper and paperboard material used in paperboard products, for both economic and environmental reasons. At present, wax–coated containers cannot be recycled. Disposal of such containers can also be a problem, and in some markets, especially in Europe, such non–recyclable packaging is becoming increasingly unacceptable. Furthermore, the wax products used to coat the containers are obtained from a non–renewable resource.

The present inventors have now developed alternative coatings for paperboard that can replace the wax coatings that are currently used.

In a first aspect, the present invention provides paperboard having a coating applied thereto, which coating includes at least one triglyceride compound.

Triglycerides have a glycerol backbone and it is expected that this would result in the triglycerides taking up appreciable amounts of water. Compounds that take up appreciable quantities of water would be considered to be unsuitable for use as coatings for paperboard. The present inventors have discovered that the triglyceride coating do, in fact, take up significant quantities of water. However, it has also been surprisingly found that paperboard coated with the triglyceride–containing coating of the present invention retains strength even after taking up water.

It has been found that applying a coating that includes at least one triglyceride

compound to paperboard produces a coated paperboard that has sufficient water resistant and crush strength in moist conditions to enable the paperboard to be suitable for the manufacture of containers for storing produce in cool rooms. Indeed, the paperboard of the present invention is suitable for fabricating containers that may be used in all applications in which present wax–coated containers are used.

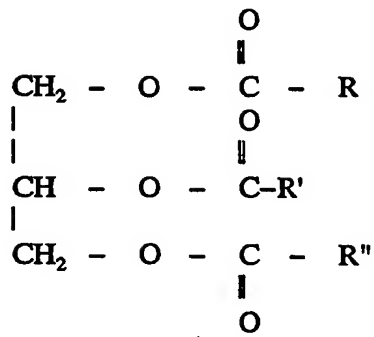
In a further aspect, the present invention provides a paperboard product characterised in that the paperboard product has a coating applied thereto, which coating includes at least one triglyceride compound.

The paperboard product is preferably a sheet of paperboard or a container blank.

In yet another aspect, the present invention provides a method for applying a coating to paperboard which comprises providing a molten coating composition including at least one triglyceride compound, applying said molten coating composition to the paperboard and allowing said molten coating composition to solidify to form said coating on the paperboard.

The molten coating composition may be applied to the paperboard by any convenient method known to those skilled in the art. Examples of suitable methods of application include passing the paperboard through a bath or pool of the molten coating composition or passing the paperboard under a shower of the molten coating composition.

Triglycerides are triesters of glycerol. The hydroxyl groups of glycerol may be esterified with the same acid to form a simple triglyceride. In mixed triglycerides, glycerol is esterified with two or three different acids. The general formula for triglycerides is shown below:



where R, R' and R" may be the same or different and are usually $C_8 - C_{22}$ hydrocarbon chains. The hydrocarbon chains may be saturated or unsaturated.

In a preferred embodiment, the coating including at least one triglyceride compound is applied to the paperboard such that the weight of the coating is up to 100% of the weight of the paperboard to which it is applied. It is preferred that the minimum amount of coating that is able to achieve that desired water permeability and crush strength parameters be applied to the paperboard. Using the minimum amount of coating will clearly minimise raw material costs. The coating is more preferably applied in an amount of 30 to 70%, based upon the weight of paperboard.

Any triglyceride that is solid under ambient conditions is suitable for use in the present invention. In general, saturated triglycerides fulfil this criterion. A number of unsaturated glycerides are also solid at room temperature (although these generally have only a small degree of unsaturation) and such unsaturated triglycerides may also be used in the present invention. A mixture containing liquid triglyceride(s) and solid triglyceride(s) may also be suitable for use.

The coating may include a single triglyceride or a mixture of two or more triglycerides. If a mixture of two or more different triglycerides are used the different triglycerides may have similar molecular weights or different molecular weights.

Example of triglycerides that may be used in the present invention include lard (a mixture of C_{14}– C_{18} saturated and unsaturated hydrocarbon chains), trimyristin (saturated tri–C_{14} hydrocarbon chains), tristearin (saturated tri–C_{18} hydrocarbon chains), hardened vegetable oil, hardened tallow, hardened fish oil, animal fats and

dripping (beef tallow). It will be appreciated that this list is not exhaustive and many others triglycerides may be used in the present invention.

One or more plasticisers may also be added to the coating in order to improve the flexibility of the coating composition. The addition of plasticizers can impart improved flexibility, increased water resistance, reduced brittleness, and affect tackiness and blocking properties. Addition of one or more plasticisers to the coating will act to reduce brittleness of the coating and hence reduce the risk of the coating flaking off the paperboard during use. The plasticiser is preferably added in an amount such that the plasticiser comprises 1–10% by weight of the total weight of the coating, with 3–5% by weight plasticisers being more preferred.

Examples of plasticisers that may be used on the present invention include low molecular weight polyester plasticisers, low density polyethylene, polyethylene wax methyl oleate, ethylene vinyl acetate (EVA) copolymers, cetosteoryl stearate, butyl stearate and beeswax. Low density polyethylene and EVA copolymers are preferred. This list of plasticisers is not exhaustive and a number of other plasticisers that are compatible with triglycerides may also be used. A mixture of different plasticisers may also be used.

Preferably, the plasticiser(s) used in the present invention are non–toxic and readily biodegradable.

To apply the coating to the paperboard, the coating composition must first be placed in the molten state. The coating composition is preferably heated to a temperature of 5–30°C above its melting point by any known heating method. For most coating compositions used in the present invention, this temperature is below 100°C and often in the range of 40 to 90°C. The actual temperature to which the coating composition is heated should be sufficiently high to ensure that the composition is molten whilst avoiding changes to the triglycerides due to elevated temperatures. In some cases where plasticisers are added to the triglyceride(s), the mixed composition goes through a gel phase as the temperature is increased, and it passes through the gel phase to a completely molten, liquid phase at higher temperatures. To ensure adequate coverage by the coating, it is important that the coating composition be heated to a temperature above that at which the gel phase

exists. Preferably, the coating composition is heated to a temperature above its cloud point. The cloud point is the temperature at which visible opacity first appears during cooling of the molten coating. The molten coating composition is then applied to the paperboard. A proportion of the applied coating is absorbed into the paperboard and the remainder coats the surface of the paperboard to form the coating. If corrugated paperboard is used, the coating preferably coats both facing sheets of the paperboard and also coats the fluted layer sandwiched between the facing sheets. The coating is then cooled to solidify the coating composition. Cooling may take place under controlled conditions. Alternatively, the coating may be allowed to cool by placing the paperboard in ambient conditions.

The molten coating composition can be applied to the paperboard by any method known to a skilled person. Preferred methods includes dipping or otherwise passing the paperboard through a bath or pool of molten coating composition, or by passing the paperboard under a shower of molten coating composition. Preferably, the coating process is controlled to saturate all surfaces of the board (including within the fluted core of corrugated board).

The coated paperboard product produced by the present invention is especially suitable for use as storage and transport containers or boxes. Preferably, the paperboard is pre-cut to a container blank prior to coating the paperboard.

The triglyceride compounds used in the present invention may be edible, are readily biodegradable and can be obtained from renewable resources, such as animal fat, fish oil and vegetable oil. In addition to producing a coated paperboard that has properties suitable for commercial applications, use of triglyceride-containing coatings allows for potentially better recyclability than current petroleum-wax coated products. Triglycerides will melt in hot water and agitation of used paperboard in hot water will remove at least some of the triglycerides from the paperboard. The triglycerides, in being less dense than water, will float and can be recovered from the surface of the water.

There are at least four other potential methods for removal of triglycerides from paperboard:

(i) detergency/emulsification,

(ii) saponification under alkaline conditions,

(iii) enzyme mediated degradation, and

(iv) repulping, optionally with flotation.

The first method is a non–destructive method and offers the possibility of separating the triglycerides from the surfactant/detergent and to recycle the triglyceride. Methods (ii) and (iii) above are destructive to the triglyceride. Method (iv) is non–destructive and offers the possibility of separating the triglycerides and recycling the triglyceride.

The invention will now be described in more detail with reference to the following Examples.

Example 1:

The water uptake of three triglyceride films in both cool room conditions and cold water immersion was investigated. The triglycerides were lard, trimyristin and tristearin. Sessile drop water contact angles for each triglyceride coating were determined to be as follows:

lard :	111 ± 5°
trimyristin:	118 ± 5°
tristearin :	112 ± 5°

Samples of coated paperboard were prepared by placing 230 Liner (paperboard) in an oven at 60°C until ready for use. 230 Liner is a commercial grade paperboard/boxboard used in the manufacture of containers and blanks therefor. This removed any water from the liner. The triglycerides were heated to approximately 20°C above their melting points and the liner was dipped in the liquid medium for about 5 seconds, after which it was removed and allowed to drain on an absorbent piece of paper. All coated materials were allowed to cool at room temperature for at least one hour before undergoing any tests. The mass of the triglyceride coatings was 0.8 to 1 times that of the original weight of the native paper.

In the water immersion tests, the native or coated samples of paper were totally immersed in a beaker of water at 4°C. At various time intervals they were removed and placed to drain on an absorbent tissue for one minute before weighing

after which they were re–immersed until next removed for re–weighing.

In the cool room tests, the native or coated samples of paper were left hanging in the humidified and temperature controlled storage unit. The cool room environment was maintained at 92% relative humidity and 2°C. At various time intervals, the paper samples were removed and placed to drain on an absorbent tissue for one minute before weighing, after which they were returned to the unit until the next weighing.

The results of the water uptake experiments are shown in Figures 1 and 2. Figure 1 shows the coolroom tests, Figure 2 shows the cold water immersion tests. As can be seen from Figures 1 and 2, all the triglyceride coatings significantly reduce the water permeation into the paperboard. For comparison purposes, similar tests were conducted for paper coated with a commercially used wax coating. These results are also shown in Figures 1 and 2.

Example 2:

Five samples of triglycerides were obtained and investigated. The samples were:

- hardened vegetable oil (fully refined);
- hardened tallow (semi–refined);
- hardened tallow (fully refined);
- hardened fish oil (semi–refined); and
- hardened fish oil (fully refined).

In the solid state triglycerides are crystalline and display polymorphism. In other words, they undergo transitions where the ordering of the crystalline hydrocarbon chains changes. There are 3 polymorphic forms (α,β' and β).

Rapid cooling from the melt may lead to the α–form. This form is thermodynamically unfavourable. Consequently, the α–form will eventually transform to another polymorphic form that has better chain packing. The usual sequence is $\alpha \rightarrow \beta' \rightarrow \beta$. For high melting point triglycerides these transformations can take weeks at room temperature and months under cool room conditions. These transformations will also take place instantaneously at well defined polymorph transition temperatures.

Coated liners using the samples mentioned above were prepared by melting the samples once then dipping the paper for *ca*. 2 seconds. Sessile drop water contact angles on the cooled coatings are given below.

	Sample	Water Contact Angle
A)	hardened vegetable oil (fully refined)	107 ± 5
B)	hardened tallow (semi–refined)	108 ± 5
C)	hardened tallow (fully refined)	106 ± 5
D)	hardened fish oil (semi–refined)	102 ± 5
E)	hardened fish oil (fully–refined)	109 ± 5

Despite the fact that these triglyceride coatings take up moisture, it has been found that the surface of all these triglyceride coatings are very hydrophobic. Water uptake experiments show that the above triglycerides are very similar to the pure tristearin.

Edge–wise crush tests were performed on corrugated board that had been saturated coated with a commercially available wax product and the above triglycerides (samples A–E). The wax product is a petroleum wax product currently used to coat paperboard and has been included for comparison purposes. The results are given in Table 1. It is clear that in dry conditions, triglyceride coatings are stronger than both the untreated board and the board that has been treated with the wax product. The results for the samples of board that have been in the cool room for 65 hours show that the triglyceride coatings (samples A–E) do impart "wet strength" to the paperboard.

Example 3:

The coating used in Example 1 and 2 were applied to paperboard that had been dried prior to coating. In commercial application, coating would be applied to paperboard that will be in equilibrium with the ambient humidity and hence will contain absorbed water. To determine if this would adversely affect the coating a series of experiments were carried out in which triglyceride coatings were applied to paperboard that had been allowed to equilibrate at ambient temperature (21°C) and humidity (50%). The coatings applied included these used in Examples 1 and 2, together with Dripping (beef tallow) and Supafry (a blended animal and vegetable

oil). For comparison purposes, similar tests were carried out using pre-dried paperboard.

Results of water uptake tests are shown in Figure 3 (pre-dried paperboard) and Figure 4 (equilibrated paper board). In the case where the paperboard had not been pre-dried, the maximum water uptake is about 30% less than that for a pre-dried liner. A general observation was that the coatings on the moisture equilibrated paperboard showed less cracking than coating on a pre-dried paperboard.

Example 4:

The experimental results obtained in Example 1 to 3 included coatings that comprised a single triglyceride. It was observed that some of these coatings were somewhat hard and brittle. Although the hardness of the coating contributed to the dry strength and the wet strength of the coated paperboard, the coatings were observed to flake off in some instances. In order to try to decrease the brittleness of the coating, an experiment was run in which small amounts of low molecular weight polyethylene (plasticiser) were added to hardened tallow (semi-refined). The results are shown in Figure 5 and reveal that small amounts (up to 5%) of low molecular weight polyethylene improved the water resistance properties of the coated paperboard.

Example 5:

A series of coatings were prepared on a boxboard substrate such that the uptake of coating on the boxboard was about 58% w/w (i.e. the coating weight was about 58% of the weight of the uncoated boxboard). The coatings used included hardened tallow, a hardened tallow/polyethylene plasticiser mix, and a commercially available wax coating. Figure 6 shows edge-wise crush strength versus water uptake after 48 hours in cool room conditions. On average, the results show that the hardened tallow and the hardened tallow/polyethylene plasticiser mixture appears to take up 2 to 3 times more water than boxboard coated with the commercially available wax coating. However, the hardened tallow and hardened tallow/polyethylene plasticiser mixture coatings impart significantly greater wet strength to the boxboard than the commercially available wax coatings.

Example 6:

Boxboard was coated with a series of coating compositions under conditions such that a coating thickness corresponding to 30% w/w was obtained. The coating method included dipping the boxboard into molten triglyceride, allowing the coating to cool and subsequently dipping into a hexane solution to remove some of the coating. The coated sample was then oven dried to remove volatile hexane.

Figure 7 shows edgewise crush strength versus water uptake for various coatings at 30% w/w after 48 hours in cool room conditions. These results show that the hardened tallow and hardened tallow/polyethylene plasticiser mixture had very similar water uptake to the commercially available wax coating and once again the commercially available wax coating had significantly smaller wet strength than the hardened tallow–based coatings.

Example 7:

To test the effectiveness of other plasticisers in the triglyceride–based coatings, a series of coatings comprising a mixture of hardened tallow and various amounts of ethylene–vinyl acetate (EVA) copolymer resin were prepared. These coatings had about 100% w/w pick–up on the paperboard substrate. As shown in Figure 7, the addition of EVA resin did not deleteriously affect the properties of the hardened tallow–based coatings. The addition of 3% and 5% EVA, by weight of the coating, to the hardened tallow, provided a water barrier equivalent to that of the commercially available wax coating.

Edge–wise crush strength versus water uptake following 48 hours in cool room conditions for hardened tallow/EVA resin coatings (comprising 97% hardened tallow and 3% EVA resin) are shown in Figures 6 and 7 for coatings having about 58% w/w and 30% w/w uptake. These coatings are thinner than the 100% w/w uptake coatings used to obtain the results shown in Figure 10. As can be seen by reference to Figures 6 and 7, the hardened tallow/EVA resin coatings had similar properties to the hardened tallow/polyethylene plasticiser coatings.

Example 8:

To assess the coating performance of triglyceride–based coatings on produce cardboard boxes, a number of boxes were coated by dipping into a pool of molten coating then removed and allowed to stand to allow the excess coating to drain off

the box.

The boxes were coated with a hardened tallow coating or a hardened tallow (97%)/polyethylene plasticiser (3%) coating and coating uptakes varied between approximately 50% w/w to 70% w/w. Boxes coated with the commercially available wax coating and prepared by normal plant procedures were also investigated for comparison.

Some of the coated produce boxes were left at ordinary ambient conditions while others were placed in cool room conditions (2°C and 95% relative humidity) for 6 days. All the boxes containing hardened tallow based coatings were weighed before and after coating. Additionally, the coated boxes were weighed after they had been conditioned. After the conditioning period, the boxes were assembled and box crush tests performed. The results of these measurements are given in Table 2.

For the boxes left at ordinary ambient conditions, the triglyceride coated boxes displayed significantly greater crush strength than the commercially available wax–coated boxes; approximately 7.5 kN, irrespective of coating uptake, for the triglyceride boxes compared with approximately 5.5 kN for the commercially available wax–coated boxes.

Boxes coated with hardened tallow (*ca.* 50% w/w) and left in the cool room conditions had an average total moisture uptake of about 9% and a box crush strength of about 3.8 kN. Boxes coated with hardened tallow/polyethylene plasticiser (*ca.* 50% w/w) and left in the cool room conditions had an average total moisture uptake of about 7% and a box crush strength of about 3.8 kN. Hence, there was not much difference in the behaviour of these *ca.* 50% w/w coatings with or without the polyethylene additive. Boxes coated with hardened tallow/polyethylene plasticiser (*ca.* 70% w/w) and left in the cool room conditions had an average total moisture uptake of about 3% and a box crush strength of about 5.4 kN. Boxes coated with the commercially available wax coating and left in the cool room conditions had an average total moisture uptake of about 1% and a box crush strength of about 5.7 kN. Hence, the hardened tallow/polyethylene plasticiser coated boxes, had similar crush strength to the wax coated boxes but the moisture uptake of the triglyceride based coatings was about 3 times more.

Example 9:

The hardened tallow used as the basis for most of the previous Examples consists mainly of C_{18} and C_{16} hydrocarbon chains. In order to investigate triglyceride blends of different chain length material, hardened coconut oil (mainly (C_{12} and C_{14}) and partially hardened fish oil (mainly C_{20} and C_{22}) were used for further trials. Figure 8 shows the water uptake in cool room conditions of paperboard coated with pure hardened coconut oil and various mixtures of tallow and hardened coconut oil. The addition of the hardened coconut oil slightly increased the water resistance of the hardened tallow–based coating. The coating of pure coconut oil increases the water resistance substantially.

Figure 9 shows the water uptake of paperboard coated with hardened tallow doped with partially hardened fish oil when placed in cool room conditions. The addition of partially hardened fish oil increases the water resistance of hardened tallow more than the fully hardened coconut oil. The coating of pure partially hardened fish oil increases the water resistance substantially. These trends probably reflect the longer alkyl chain length of the partially hardened fish oil and the fluidity of the unsaturated components. Although the water resistance of both the hardened coconut oil and the partially hardened fish oil appear to be superior to the hardened tallow, their melting point behaviour and mechanical strength would be inappropriate for them to be the major component of a commercial coating.

Example 10

Hardened tallow was mixed with various additives in order to investigate the properties of the resulting mixture. The additives included tributyrin, dodecanol, beeswax, butyl stearate, cetostearyl stearate, lanolin and methyl stearate. All of these additives improved the relative flexibility/flaking of the hardened tallow, with some of the fatty acid ester materials (butyl stearate, cetostearyl stearate and lanolin) having the best effect.

Water uptake tests showed that coatings of hardened tallow doped with from 1 to 5% of butyl stearate, or cetostearyl stearate had similar water resistance properties to pure hardened tallow. The addition of 1 to 5% beeswax to the hardened tallow increased the water resistance properties of the hardened tallow–

based coating.

Figures 6 and 7 also contain edgewise crush strength versus water uptake for boxboard for hardened tallow–based coatings containing 3% of either butyl stearate or cetostearyl stearate, after 48 hours in cool room conditions. The coatings have similar properties to the hardened tallow/polyethylene plasticiser coatings.

Example 11

The previous Examples detailed investigations of paperboard coated by dipping the paperboard into molten coating material. It is believed that this coating method does not result in ideal coatings. Therefore, a pilot scale cascade coater was constructed to enable coating to take place under controlled conditions whilst using a process similar to that used on the commercial scale. The cascade coater comprises a heated lower reservoir for holding a pool of molten coating material. A pump is used to raise the molten coating material to an upper reservoir having a weir. Overflow from the upper reservoir cascades over the weir and a box blank can be moved back and forwards through the falling cascade to coat the blank. The pilot scale cascade coater allows for accurate control of the temperature of the molten coating material, flow of the molten coating material and air flow. Variable coating thicknesses can be obtained using the cascade coater.

A series of trials were conducted using the pilot scale cascade coater in which cardboard box blanks were coated. After the coating had hardened, the box blanks were folded into boxes and box crush tests were conducted on the boxes, after the boxes had been exposed to ambient conditions (23°C, 50% relative humidity) or cool room conditions (2°C, 95% relative humidity, 72 hours). The trials were conducted using a commercially available wax coating and a triglyceride coating comprising 97% hardened tallow and 3% polyethylene plasticiser. Both coatings were applied at variable coating pick–up. The boxes used had dimensions of 570 x 370 x 300 mm (approximately) and were made from corrugated boxboard. The results of these trials are given in Tables 3 to 11. Table 12 shows a 50% w/w coating comprising 95% hardened Tallow and 5% polyester plasticiser.

Comparison of the results for the commercially available wax coating and the triglyceride–based coating show that the boxes coated with the triglyceride–based

coating have superior dry strength to the wax coated boxes, but exhibit slightly lower wet strength than the wax coated boxes. Strength increased with increasing coating uptake. Table 13 shows dry strength and wet strength properties of uncoated paperboards. The results of Table 13 clearly show that the coating of the present invention improves the dry strength of the boxes and markedly increases the wet strength of the boxes.

The triglyceride–based coatings of the present invention produce coated paperboard articles that exhibit satisfactory wet strength properties. The coatings are transparent, made from a non–solvent base and are sourced from renewable resources.

A very important feature of the triglyceride–based coating of the present invention is that they allow for recycling of the paperboard. Initial trials using boxboard coated with a coating comprising 97% hardened tallow and 3% polyethylene plasticiser were conducted using a laboratory scale repulper in order to assess the recyclability of the paperboard. It was found that the triglyceride coated boxes defibred quite readily. Hand drawn sheets were made from the repulped material and the quality of the material so–produced was similar to that of recycled uncoated boxboard. It was noted that more beating/repulping time was required to recycle the triglyceride–coated boxes.

As a further advantage of the present invention, the triglyceride materials used in the coatings are readily hydrolysed to form fatty acids which are readily biodegradable under both aerobic and anaerobic conditions. Thus, the coating material is unlikely to persist in the environment if coated boxes are disposed of as waste rather than being recycled.

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically disclosed. It is to be understood that the invention is considered to encompass all such variations and modifications that are all within its spirit and scope.

List of Chemicals:

The following chemicals were used in the Examples listed in this specification:

1) All triglyceride compounds obtained from Unichema Australia:
Hardened vegetable oil – fully refined; Unichema Prifat 9834
Hardened tallow – semi–refined; Unichema Prifat 9813
Hardened tallow – fully refined; Unichema Prifat 9833
Hardened fish oil – semi–refined; Unichema Prifat 9811
Hardened fish oil – fully refined; Unichema Prifat 9832
2) Polyethylene plasticizer – Polywax 500 (Dussek Campbell)
3) Commercially available wax coating – Surfowax 7111
4) Dripping (beef tallow) – Wik Industries Australia
5) Supafry (blended animal and vegetable oil) – Meadow Lea
6) Lard – "Dandy" brand – Metro Quality Foods
7) Tristearin (≥ 99% pure) – Sigma
8) Trimyristin (≥ 99% pure) – Kodak
9) Cetostearyl stearate – Unichema
10) Butyl stearate – BDH
11) Fully hardened coconut oil – Swift & Co.
12) Partially hardened fish oil – Swift & Co.

TABLE 1

EDGEWISE CRUSH TEST

BOARD GRADE: 220 EC.W/150/225 K 'C'
TIME IN HUMID ENVIRONMENT (2°C & 92% RH): 65 HOURS

	UNTRD	WAX	SAMPLE A	SAMPLE B	SAMPLE C	SAMPLE D	SAMPLE E
DRY WEIGHT (G) OF 7 SAMPLES	12.05	22.64	19.91	22.68	21.05	20.62	22.64
HUMID WEIGHT (G) OF 7 SAMPLES	13.52	22.94	21.11	23.88	22.33	21.88	23.72
MOISTURE CONTENT UNTREATED	18.6%						
E.C.T. (KN/M)							
DRY	9.19	11.86	15.29	12.74	13.62	14.20	13.55
	9.27	11.83	14.28	13.18	13.80	14.34	14.36
	8.94	11.65	14.52	12.29	13.80	13.67	14.15
	8.98	11.67	14.69	12.40	13.79	13.99	13.67
	9.14	11.96	14.53	12.92	14.27	14.29	13.52
	9.33	12.03	14.55	12.21	14.04	13.60	14.29
	7.93	12.11	14.46	12.54	14.01	13.76	14.10
AV:	8.97 ± 0.44	11.87 ± 0.16	14.62 ± 0.23	12.61 ± 0.33	13.90 ± 0.20	13.98 ± 0.28	13.95 ± 0.33
HUMID	2.55	9.05	7.26	6.18	6.65	6.49	7.50
	2.34	8.46	7.78	5.98	6.90	6.96	7.28
	2.44	8.95	7.40	6.25	6.70	6.55	7.39
	2.49	7.99	7.54	6.43	6.78	6.65	7.29
	2.49	7.78	7.45	5.98	7.00	6.94	6.93
	2.29	7.31	7.31	6.37	7.20	6.72	7.75
	2.39	7.13	7.21	6.46		6.91	7.70
AV:	2.43 ± 0.09	8.04 ± 0.70	7.42 ± 0.18	6.23 ± 0.19	6.87 ± 0.19	6.75 ± 0.18	7.41 ± 0.26

TABLE 2

HARDENED TALLOW

Code	Carton Weight (g)	Dipped Weight (g)	Oven Dried wt (g)	% w/w Pick Up	Humid Room wt 6 days 2°C/95% RH	BCT (kN)	Moisture (%)
1	840	1410	1220	45	1340	4.13	9.8
2	840	1430	1266	50	1365	3.89	7.8
3	841	1413	1250	49	1370	3.73	9.6
4	842	1390	1300	54	Ambient	7.59	
5	837		1330	58	1445	3.69	8.6
6	837		1350	61	Ambient	7.31	
7	842		1225	46	1350	3.64	10.2
8	842		1250	49	Ambient	7.45	
9	842		1278	52	1395	3.89	9.2
10	842		1287	53	Ambient	7.41	
11	828		1290	56	1406	3.67	9.0
12	842		1295	54	1400	4.15	8.2

HARDENED TALLOW + 3% POLYETHYLENE PLASTICISER

Code	Carton Weight (g)	Dipped Weight (g)	Oven Dried wt (g)	% w/w Pick Up	Humid Room wt 6 days 2°C/95%RH	BCT (kN)	Moisture (%)
A	827	1425	no oven drying	72	1460	5.50	2.4
B	827	1450	1225	48	1335	3.18	8.2
C	827	1446	1265	53	Ambient	7.47	
D	827	1435	1217	47	Ambient	7.14	
E	827	1428	no oven drying	73	1473	5.33	3.2
F	827	1451	1278	54	1365	3.41	6.8
G	827	1433	1243	50	Ambient	7.62	
H	827	1432	no oven drying	72	Ambient	7.44	
I	830	1433	1283	55	Ambient	7.71	
J	830	1439	1230	48	1325	3.99	7.7
K	831	1432	1310	57	1385	4.65	5.7
L	838	1432	1250	50	Ambient	7.74	

TABLE 3

<u>Coating</u> : 40% w/w wax coating
<u>Wax temp</u> : 87 Deg. C
<u>Standing time</u> : 180 secs.

Ctn No.	Weight of Ctn (initial)	Weight of Ctn. (treated)	% Pick-Up	Weight of Ctn. (Humid)	BCT (kN) Ambient	BCT (kN) Humid
T6-1	738	1053	43	1082	-	6.29
T6-2	736	1054	43	1083	-	6.01
T6-3	738	1055	43	1081	-	5.98
T6-4	739	1053	43	1083	-	6.2
T6-5	742	1059	43	1089	-	5.77
T6-6	740	1058	43	1091	-	5.51
T6-7	744	1057	42	1092	-	5.55
T6-8	745	1053	41	1081	-	6.02
T6-9	747	1055	41	1087	-	5.49
T6-10	738	1056	43	1083	-	5.45
Average	741	1055	43	1085		5.83
T6-11	739	1056	43	-	5.78	-
T6-12	737	1052	43	-	5.94	-
T6-13	739	1051	42	-	6.17	-
T6-14	740	1059	43	-	6.00	-
T6-15	742	1059	43	-	6.28	-
T6-16	743	1057	42	-	6.11	-
T6-17	744	1061	43	-	5.97	-
T6-18	743	1061	43	-	6.16	-
T6-19	745	1062	43	-	6.18	-
T6-20	477	1064	43	-	5.98	-
Average	742	1058	43		6.06	

TABLE 4

Coating	:	50% w/w wax
Wax temp	:	87 Deg. C
Standing time	:	60 secs.
Cabin temp	:	87 Deg. C

Ctn No.	Weight of Ctn (initial)	Weight of Ctn. (treated)	% Pick-Up	Weight of Ctn. (Humid)	BCT (kN) Ambient	BCT (kN) Humid
TS-1	743	1132	52	1154	-	6.23
TS-2	741	1118	51	1142	-	6.05
TS-3	742	1116	50	1143	-	5.71
TS-4	738	1102	49	1131	-	5.87
TS-5	735	1122	53	1143	-	6.08
TS-6	735	1115	52	1138	-	6.19
TS-7	735	1109	51	1137	-	6.07
TS-8	734	1120	53	1137	-	5.89
TS-9	741	1115	50	1138	-	6.08
TS-10	740	1116	51	1141	-	5.92
Average	738	1117	51	1140		6.01
TS-11	740	1118	51	-	5.64	-
T6-12	738	1119	52	-	5.91	-
TS-13	738	1113	51	-	5.68	-
TS-14	732	1111	52	-	5.99	-
TS-15	747	1112	49	-	5.37	-
TS-16	747	1120	50	-	5.33	-
TS-17	746	1119	50	-	5.36	-
TS-18	743	1111	50	-	5.87	-
TS-19	741	1114	50	-	5.85	-
TS-20	740	1113	50	-	5.52	-
Average	742	1115	51		5.63	

TABLE 5

Coating : 40% w/w wax
Wax temp : 87 Deg. C
Standing time : 0
Cabin Temp : 87 Deg. C

Ctn No.	Weight of Ctn (initial)	Weight of Ctn. (treated)	% Pick-Up	Weight of Ctn. (Humid)	BCT (kN) Ambient	BCT (kN) Humid
T4-1	737	1189	61	1213	-	6.34
T4-2	739	1178	59	1203	-	6.11
T4-3	739	1163	57	1189	-	6.12
T4-4	743	1197	61	1216	-	6.02
T4-5	743	1171	58	1198	-	6.91
T4-6	737	1193	62	1217	-	6.03
T4-7	734	1187	62	1210	-	6.17
T4-8	733	1189	62	1212	-	1.18
T4-9	735	1191	62	1214	-	5.93
T4-10	734	1196	63	1218	-	5.98
Average	737	1185	61	1209		6.18
T4-11	733	1191	62	-	6.19	-
T4-12	732	1191	63	-	6.02	-
T4-13	729	1188	63	-	5.92	-
T4-14	733	1187	62	-	6.01	-
T4-15	734	1189	62	-	5.99	-
T4-16	744	1193	60	-	5.83	-
T4-17	740	1199	62	-	6.00	-
T4-18	739	1179	60	-	5.52	-
T4-19	739	1192	61	-	5.86	-
T4-20	748	1204	61	-	5.90	-
Average	737	1191	62		5.92	

TABLE 6

Coating : 70% w/w wax
Wax temp : 75 Deg. C
Standing time : 15 secs.
Cabin temp : 75 Deg. C

Ctn No.	Weight of Ctn (initial)	Weight of Ctn. (treated)	% Pick-Up	Weight of Ctn. (Humid)	BCT (kN) Ambient	BCT (kN) Humid
T7-1	735	1259	71	1272	-	6.55
T7-2	736	1276	73	1292	-	6.31
T7-3	738	1257	70	1275	-	6.83
T7-4	738	1285	74	1301	-	6.79
T7-5	737	1244	69	1278	-	7.17
T7-6	740	1258	70	1273	-	6.04
T7-7	741	1280	73	1295	-	6.55
T7-8	741	1255	69	1271	-	6.54
T7-9	739	1281	73	1298	-	6.62
T7-10	739	1266	71	1282	-	6.40
Average	738	1266	71	1284		6.58
T7-11	745	1308	76	-	5.81	-
T7-12	747	1256	68	-	5.91	-
T7-13	749	1289	72	-	6.23	-
T7-14	751	1268	69	-	6.09	-
T7-15	751	1268	69	-	5.86	-
T7-16	734	1259	72	-	5.95	-
T7-17	733	1260	72	-	6.19	-
T7-18	735	1251	70	-	5.95	-
T7-19	736	1255	71	-	5.77	-
T7-20	734	1269	73	-	6.04	-
Average	742	1268	71		5.98	

TABLE 7

Coating	:	80% w/w wax
Wax temp	:	75 Deg. C
Standing time	:	10 secs.
Cabin temp	:	70 Deg. C

Ctn No.	Weight of Ctn (initial)	Weight of Ctn. (treated)	% Pick-Up	Weight of Ctn. (Humid)	BCT (kN) Ambient	BCT (kN) Humid
T8-1	749	1356	81	1365	-	6.87
T8-2	747	1344	80	1355	-	6.62
T8-3	744	1324	78	1336	-	6.67
T8-4	742	1321	78	1333	-	6.53
T8-5	741	1326	79			
Average	745	1334	79	1347		6.67
T8-6	740	1329	80	-	6.76	-
T8-7	738	1331	80	-	6.67	-
T8-8	739	1339	81	-	6.42	-
T8-9	736	1335	81	-	6.47	-
T8-10	738	1344	82	-	6.64	-
Average	738	1336	81		6.59	

TABLE 8

<u>Coating</u> : 50% w/w 97% hardened tallow/3%polyethylene plasticiser
<u>Wax temp</u> : 87 Deg. C
<u>Standing time</u> : 60 secs.
<u>Cabin temp</u> : 87 Deg. C

Ctn No.	Weight of Ctn (initial)	Weight of Ctn. (treated)	% Pick-Up	Weight of Ctn. (Humid)	BCT (kN) Ambient	BCT (kN) Humid
T11-1	740	1126	52	-	7.48	-
T11-2	754	1149	52	-	7.40	-
T11-3	749	1146	53	-	7.68	-
T11-4	751	1151	53	-	7.60	-
T11-5	749	1149	53	-	7.39	-
T11-6	747	1146	53	-	7.51	-
T11-7	748	1149	54	-	7.86	-
T11-8	748	1140	53	-	7.66	-
T11-9	742	1142	54	-	7.47	-
T11-10	739	1138	54	-	7.64	-
Average	747	1144	53		7.57	
T11-11	738	1165	58	1196	-	5.54
T11-12	741	1147	55	1193	-	5.27
T11-13	739	1146	55	1197	-	4.90
T11-14	764	1155	51	1205	-	5.16
T11-15	748	1145	53	1191	-	4.84
T11-16	746	1146	54	1203	-	5.40
T11-17	743	1145	54	1200	-	4.79
T11-18	742	1145	54	1205	-	5.09
T11-19	743	1143	54	1196	-	5.44
T11-20	744	1146	54	1195	-	
Average	745	1148	54	1198		5.16

TABLE 9

<u>Coating</u> : 60% w/w 97% hardened tallow/3% polyethylene plasticiser
<u>Wax temp</u> : 87 Deg. C
<u>Standing time</u> : 0
<u>Cabin temp</u> : 87 Deg. C

Ctn No.	Weight of Ctn (initial)	Weight of Ctn. (treated)	% Pick-Up	Weight of Ctn. (Humid)	BCT (kN) Ambient	BCT (kN) Humid
T10-1	759	1217	60	1259	-	4.99
T10-2	749	1208	61	1255	-	5.66
T10-3	747	1202	61	1246	-	5.46
T10-4	747	1194	60	1243	-	5.08
T10-5	745	1189	60	1236	-	5.24
T10-6	745	1180	58	1240	-	3.95
T10-7	743	1198	61	1249	-	5.23
T10-8	744	1197	61	1237	-	5.57
T10-9	750	1214	62	1259	-	5.57
T10-10	753	1219	62	1257	-	5.49
Average	748	1202	61	1248		5.22
T10-11	751	1202	60	-	7.79	-
T10-12	752	1224	63	-	8.09	-
T10-13	756	1220	61	-	7.48	-
T10-14	759	1228	62	-	7.88	-
T10-15	746	1215	63	-	7.51	-
T10-16	742	1182	59	-	7.59	-
T10-17	745	1208	62	-	7.44	-
T10-18	747	1207	62	-	7.47	-
T10-19	744	1213	63	-	7.68	-
T10-20	743	1213	63	-	7.62	-
Average	749	1211	62		7.66	

TABLE 10

<u>Coating</u> : 70% w/w 97% hardened tallow/3% polyethylene plasticiser
<u>Wax temp</u> : 75 Deg. C
<u>Standing time</u> : 15 secs.
<u>Cabin temp</u> : 75 Deg. C

Ctn No.	Weight of Ctn (initial)	Weight of Ctn. (treated)	% Pick-Up	Weight of Ctn. (Humid)	BCT (kN) Ambient	BCT (kN) Humid
T12-1	750	1256	67	1279	-	5.82
T12-2	754	1240	64	1263	-	5.84
T12-3	747	1250	67	1275	-	5.86
T12-4	749	1233	65	1258	-	5.97
T12-5	747	1243	66	1271	-	5.61
T12-6	743	1228	65	1255	-	5.73
T12-7	744	1245	67	1272	-	5.72
T12-8	748	1237	65	1266	-	6.09
T12-9	745	1249	68	1274	-	6.10
T12-10	745	1237	66	1263	-	
Average	747	1242	66	1268		5.86
T12-11	746	1251	68	-	7.47	-
T12-12	748	1241	66	-	7.49	-
T12-13	737	1256	70	-	8.05	-
T12-14	738	1244	69	-	7.55	-
T12-15	743	1241	67	-	8.10	-
T12-16	743	1259	69	-	7.76	-
T12-17	742	1245	68	-	7.98	-
T12-18	745	1238	66	-	7.85	-
T12-19	747	1242	66	-	7.31	-
T12-20	750	1248	66	-	7.79	-
Average	744	1247	68		7.74	

TABLE 11

Coating 45% w/w; 97% Hardened Tallow/3% Polyethylene Plasticizer

Ctn No.	Weight of Ctn (initial)	Weight of Ctn. (treated)	% Pick-Up	Weight of Ctn. (Humid)	BCT (kN) Ambient	BCT (kN) Humid
T13-1	754	1111	47	1161	-	5.43
T13-2	750	1075	43	1165	-	3.76
T13-3	748	1082	45	1153	-	4.38
T13-4	747	1088	46	1185	-	3.76
T13-5	749	1090	46	1178	-	3.93
T13-6	750	1091	45	1167	-	4.69
T13-7	751	1091	45	1152	-	5.95
T13-8	751	1087	45	1163	-	4.94
T13-9	753	1098	46	1159	-	5.13
T13-10	753	1105	47	1157	-	5.65
Average	751	1092	48	1164		4.76
T13-11	753	1100	46	-	7.29	-
T13-12	752	1098	46	-	7.81	-
T13-13	751	1108	47	-	7.49	-
T13-14	753	1102	46	-	7.54	-
T13-15	756	1113	47	-	7.14	-
T13-16	752	1098	46	-	7.65	-
T13-17	752	1101	46	-	7.49	-
T13-18	752	1102	47	-	7.49	-
T13-19	755	1105	46	-	7.84	-
T13-20	755	1099	46	-		-
Average	753	1103	46		7.53	

TABLE 12

Coating: 45% w/w; 95% Hardened Tallow/5% Polyethylene Plasticizer

Ctn No.	Weight of Ctn (initial)	Weight of Ctn. (treated)	% Pick-Up	Weight of Ctn. (Humid)	BCT (kN) Ambient	BCT (kN) Humid
T14-1	760	1166	53	-	6.97	-
T14-2	758	1162	53	-	7.32	-
T14-3	754	1159	54	-	7.45	-
T14-4	755	1157	53	-	6.89	-
T14-5	757	1155	53	-	7.31	-
T14-6	755	1155	53	-	7.22	-
T14-7	752	1151	53	-	7.32	-
T14-8	753	1144	52	-	7.17	-
T14-9	753	1145	52	-	6.94	-
T14-10	750	1141	52	-	7.32	-
Average	755	1154	53		7.19	
T14-11	751	1139	52	1186	-	5.26
T14-12	753	1138	51	1195	-	5.24
T14-13	752	1148	53	1187	-	5.90
T14-14	757	1156	53	1199	-	5.60
T14-15	754	1146	52	1196	-	5.38
T14-16	755	1152	53	1198	-	5.51
T14-17	749	1145	53	1205	-	5.06
T14-18	750	1150	53	1198	-	5.61
T14-19	753	1154	53	1194	-	6.06
T14-20	753	1169	55	1203	-	5.85
Average	753	1150	53	1196		5.55

TABLE 13

Uncoated Properties

Ctn No.	BCT (kN) Ambient	BCT (kN) Humid	Moist. Cont (%)
1	4.86	-	7.92
2	4.85	-	7.99
3	4.63	-	7.86
4	5.01	-	8.09
5	4.71	-	8.26
6	4.92	-	8.17
7	5.09	-	7.91
8	4.74	-	8.11
9	4.99	-	8.14
Average	4.87		8.05
11	-	1.57	20.2
12	-	1.87	20.1
13	-	1.62	20.8
14	-	1.57	21.2
15	-	1.77	20.2
16	-	1.74	21.8
17	-	1.62	20.5
18	-	1.71	20.0
Average		1.68	20.61

CLAIMS:

1. Paperboard having a coating applied thereto, which coating includes at least one triglyceride compound.

2. Paperboard as claimed in claim 1 wherein the coating is applied in an amount of up to 100% of the weight of the paperboard.

3. Paperboard as claimed in claim 2 wherein the coating is applied in an amount of from about 30% to about 80% w/w of the weight of the paperboard.

4. Paperboard as claimed in any one of claims 1 to 3 wherein the coating includes a single triglyceride compound.

5. Paperboard as claimed in any one of claims 1 to 3 wherein the coating includes two or more triglyceride compounds.

6. Paperboard as claimed in claim 5 wherein the mixture of two or more triglyceride compounds comprises at least one triglyceride compound that is a solid at ambient temperature and at least one triglyceride compound that is a liquid at ambient temperature, the mixture being solid at ambient temperature.

7. Paperboard as claimed in claim 1 wherein the at least one triglyceride compound is selected from lard, trimyristin, tristearin, hardened vegetable oil, hardened tallow, hardened fish oil, dripping or mixtures thereof.

8. Paperboard as claimed in any one of the preceding claims wherein the coating further includes one or more plasticisers.

9. Paperboard as claimed in claim 8 wherein the one or more plasticisers is/are present in any amount of from about 1% to about 10% by weight of the weight of the coating.

10. Paperboard as claimed in claim 9 wherein the one or more plasticisers is/are present in an amount of from about 3% to about 5% by weight of the weight of the coating.

11. Paperboard as claimed in any one of claims 8 to 10 wherein the one or more plasticisers is selected from low molecular weight polyester plasticisers, low density polyethylene, polyethylene wax, methyl oleate, ethylene vinyl acetate (EVA) copolymers, butyl stearate, cetostearyl stearate, beeswax and mixtures thereof.

12. A paperboard product made from paperboard in accordance with any

one of claims 1 to 11.

13. A paperboard product as claimed in claim 12 wherein the paperboard product is a box or a box blank.

14. A method of applying a coating to a paperboard product which coating includes at least one triglyceride compound, which method comprises heating the at least one triglyceride compound to a temperature above its melting point to thereby melt the at least one triglyceride compound, applying the molten at least one triglyceride compound to the paperboard product and allowing the coating to harden.

15. A method as claimed in claim 14 wherein the at least one triglyceride compound is heated to a temperature above the cloud point thereof.

16. A method as claimed in claim 14 wherein the at least one triglyceride compound is heated to a temperature 5 to 30°C above its melting temperature.

17. A method as claimed in claim 14 wherein one or more plasticisers are present in the molten at least one triglyceride compound.

18. A method as claimed in any one of claims 14 to 17 wherein the molten at least one tryglyceride compound is applied to the paperboard product by passing the paperboard product through a curtain or cascade of the molten at least one triglyceride compound.

FIG. 1.

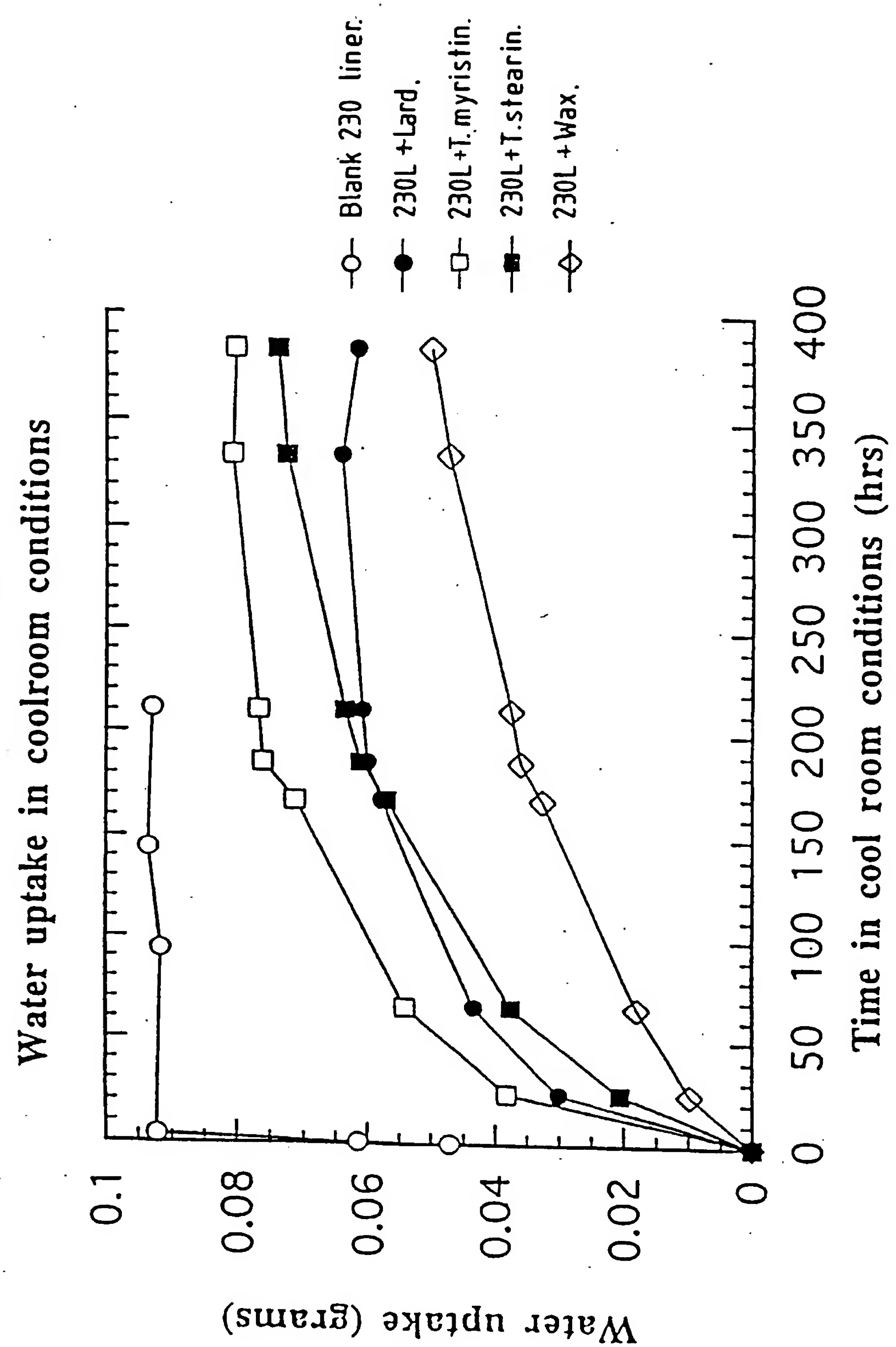

Water uptake in coolroom conditions
Water uptake (grams)
0.1
0.08
0.06
0.04
0.02
0
Time in cool room conditions (hrs)
0
50
100
150
200
250
300
350
400
Blank 230 liner.
230L +Lard.
230L+T.myristin.
230L+T.stearin.
230L +Wax.

FIG. 2.

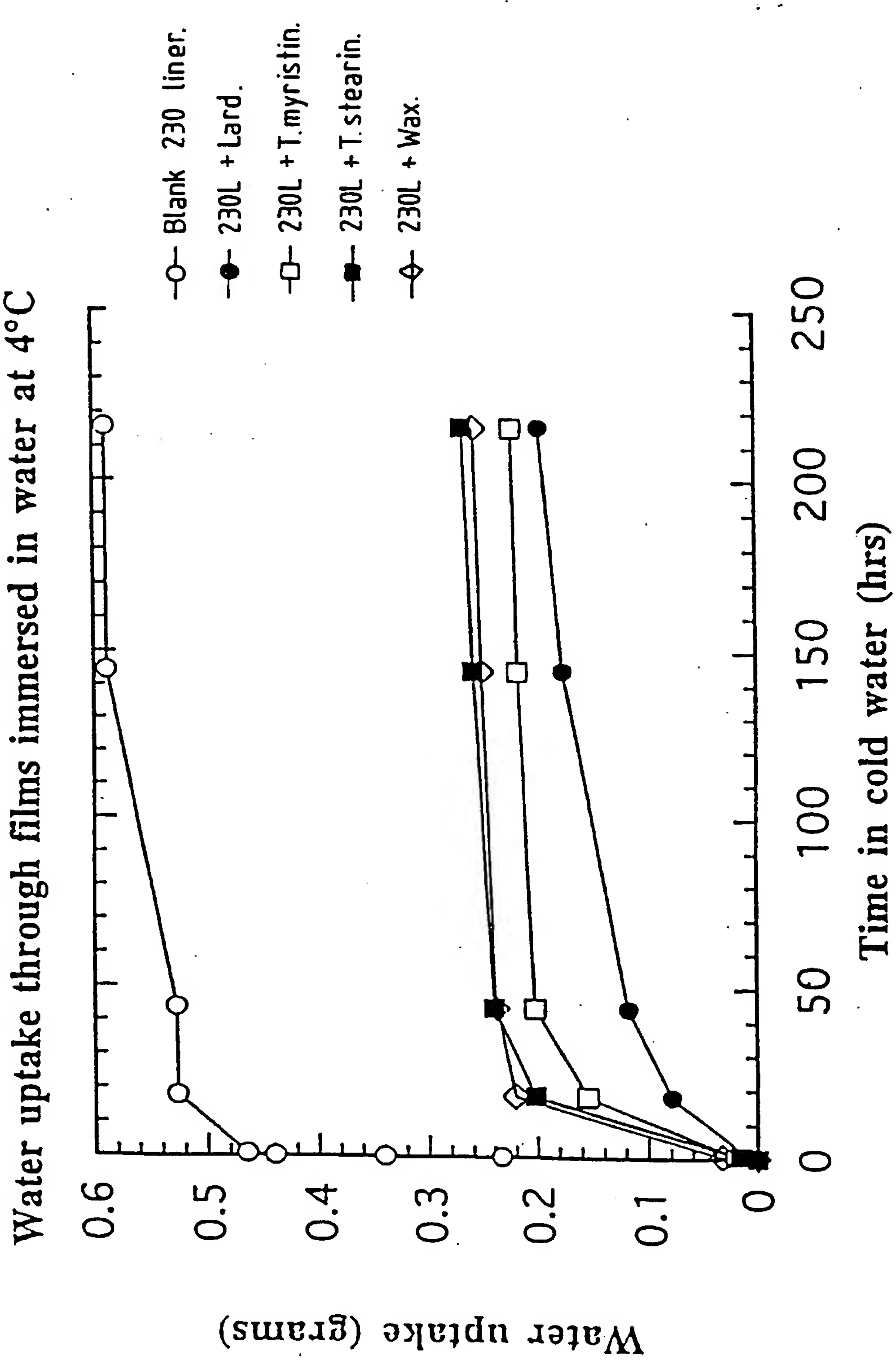

Water uptake through films immersed in water at 4°C
Water uptake (grams)
0
0.1
0.2
0.3
0.4
0.5
0.6
Time in cold water (hrs)
0
50
100
150
200
250
Blank 230 liner.
230L + Lard.
230L + T.myristin.
230L + T.stearin.
230L + Wax.

FIG. 3.

Water uptake of pre-dried 230 liner coated with various coatings

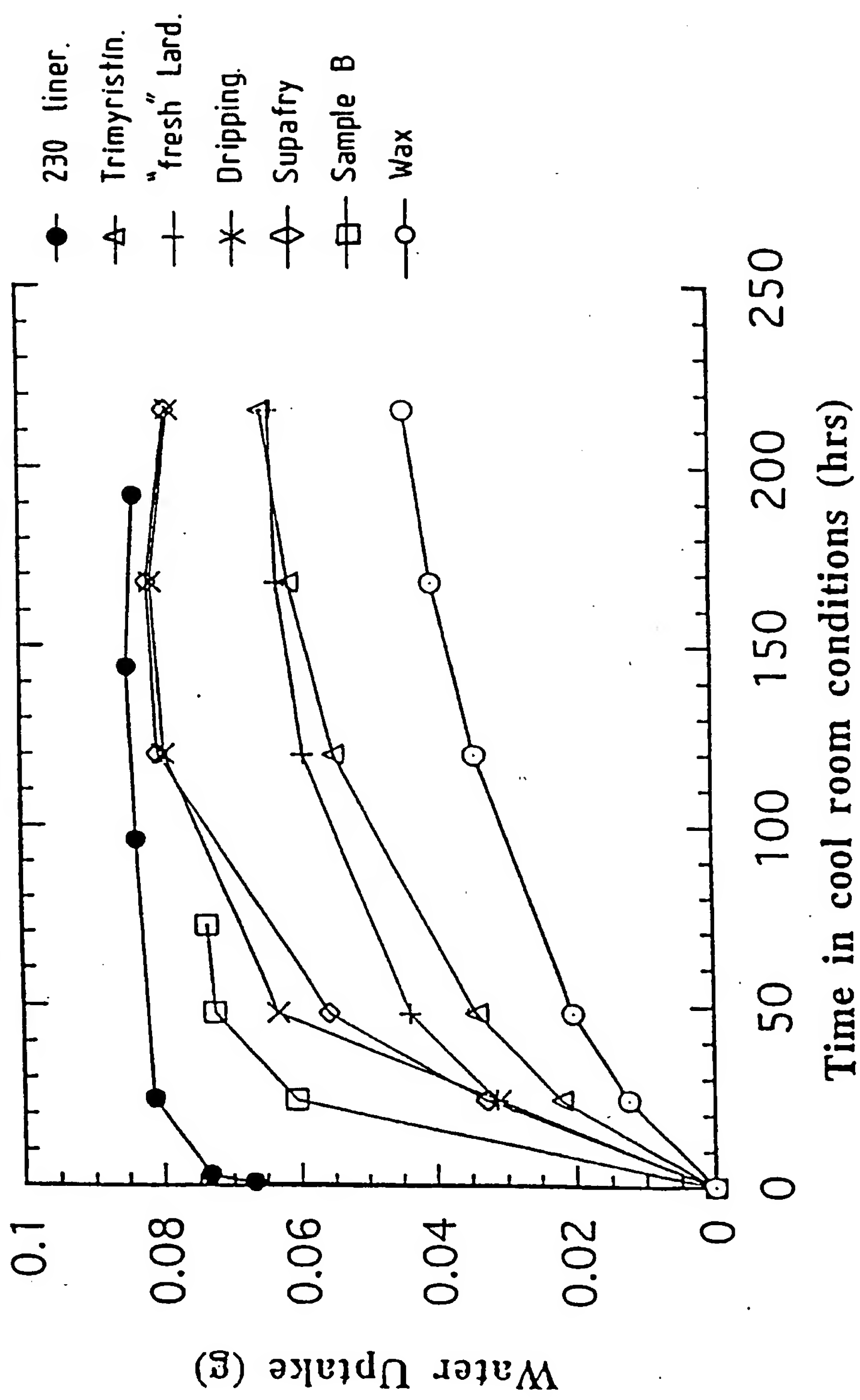


FIG. 4.

Water Uptake of room equilibrated 230 liner coated with various coatings

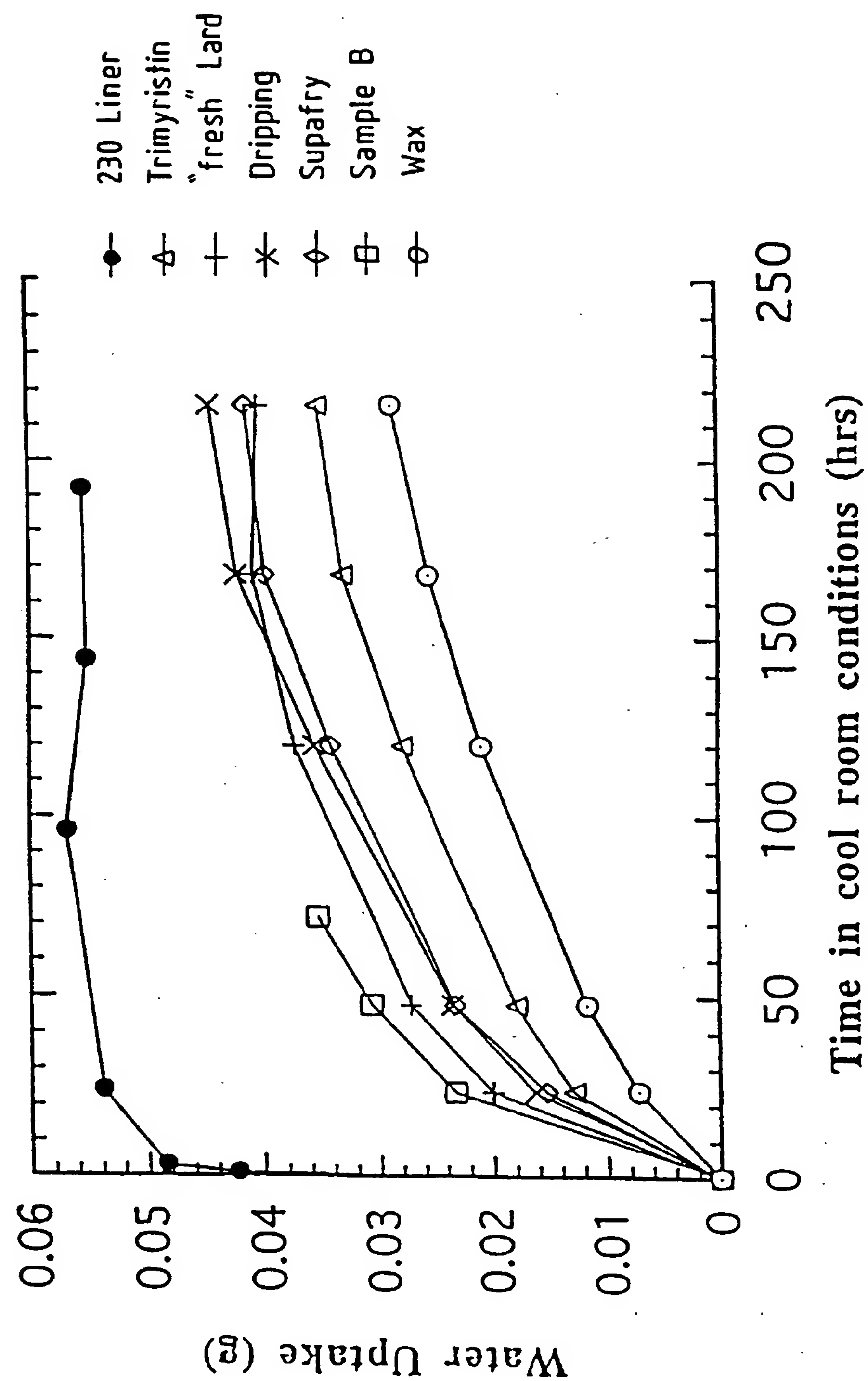


FIG. 5.

Water Uptake of room equilibrated 230 liner
coated with various mixtures of Union Carbide PE & Prifat 9813

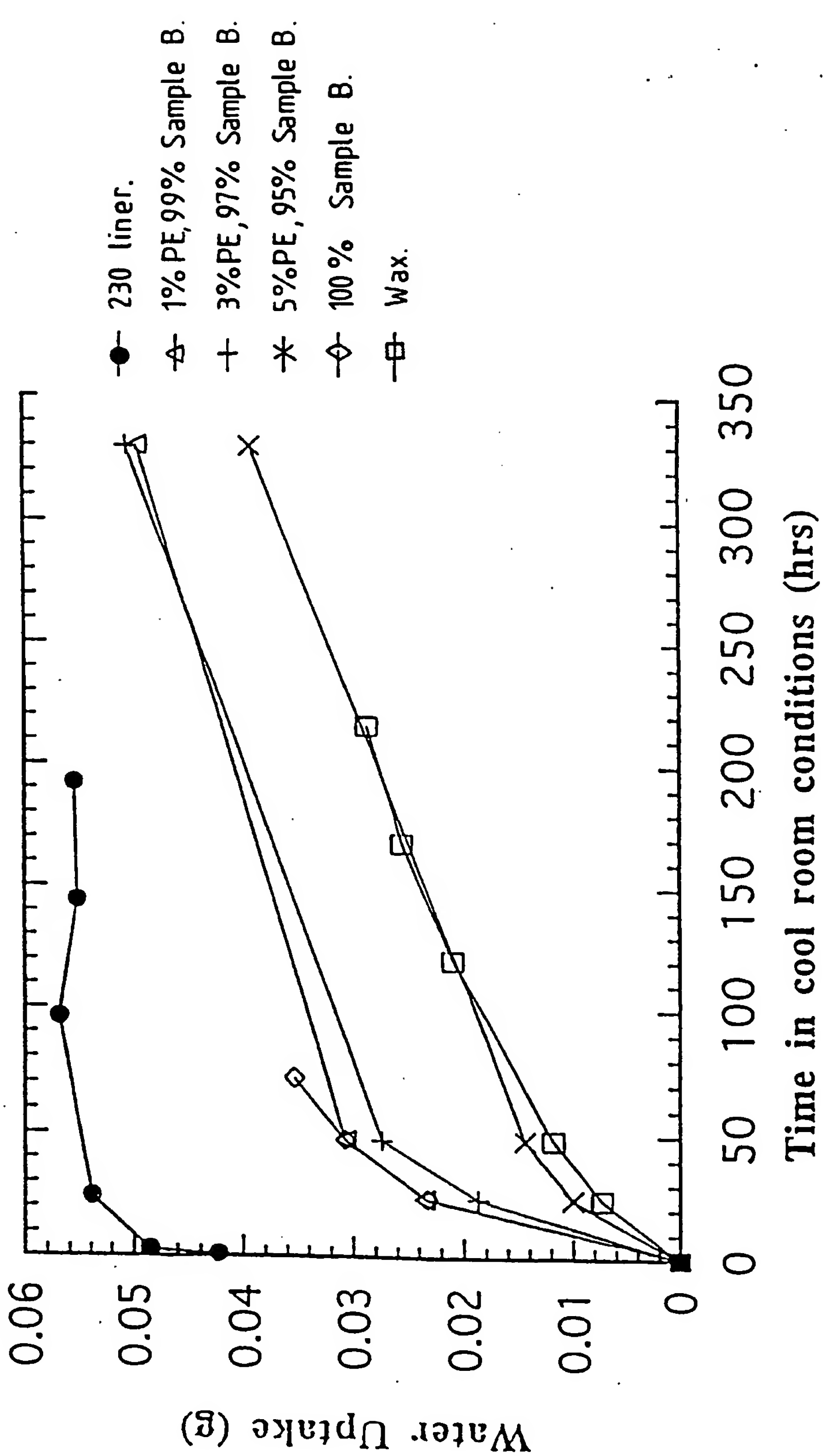


FIG. 6.

Crush strength versus water uptake of boxboard (220EC.W/150/225K C flute) coated with various coatings at 58% w/w pick-up after 48hrs in cool room conditions

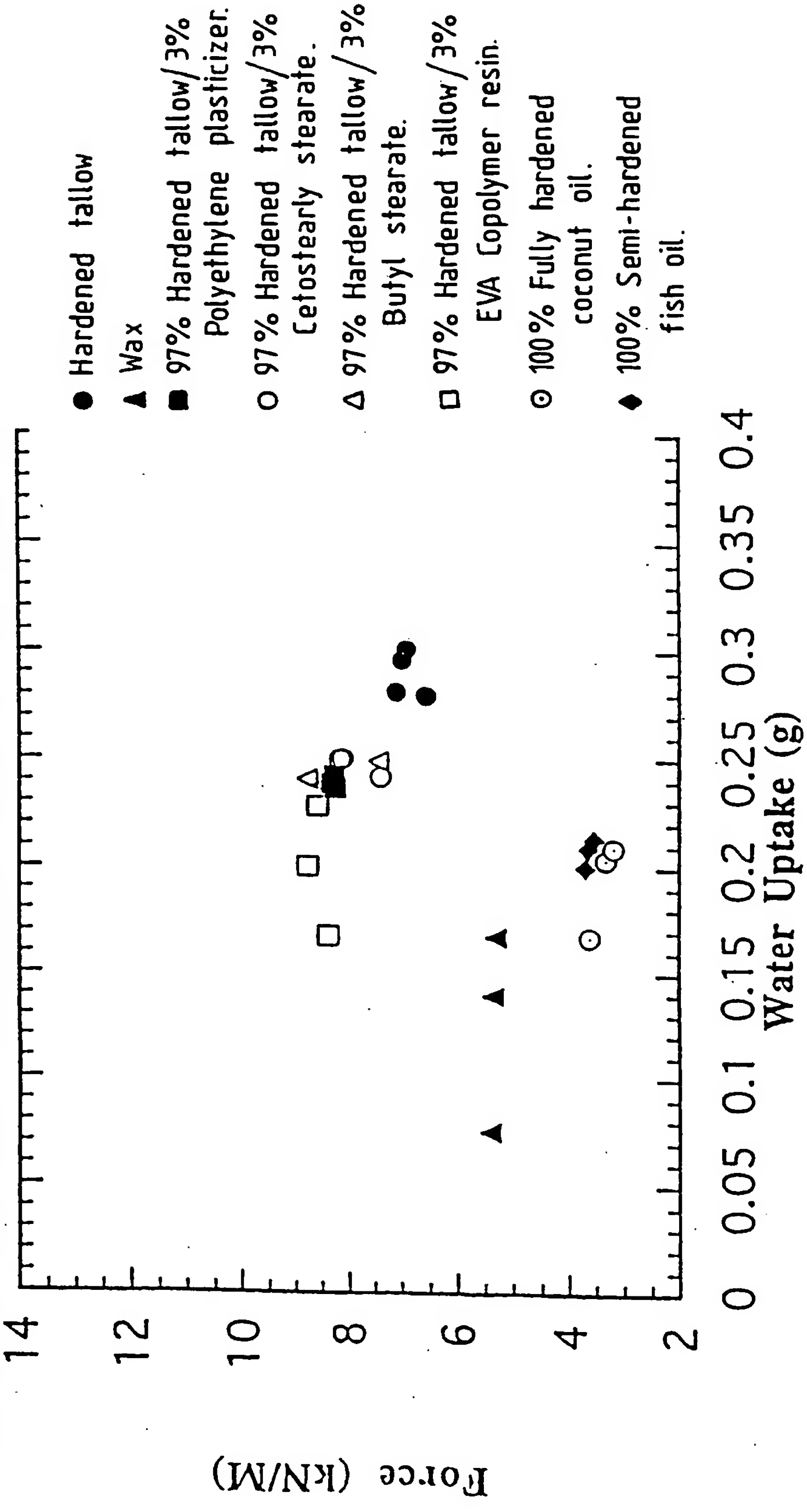


FIG. 7.

Crush strength versus water uptake of boxboard (220EC.W/150/225K C flute) coated with various coatings at 30% w/w pick-up after 48hrs in cool room conditions

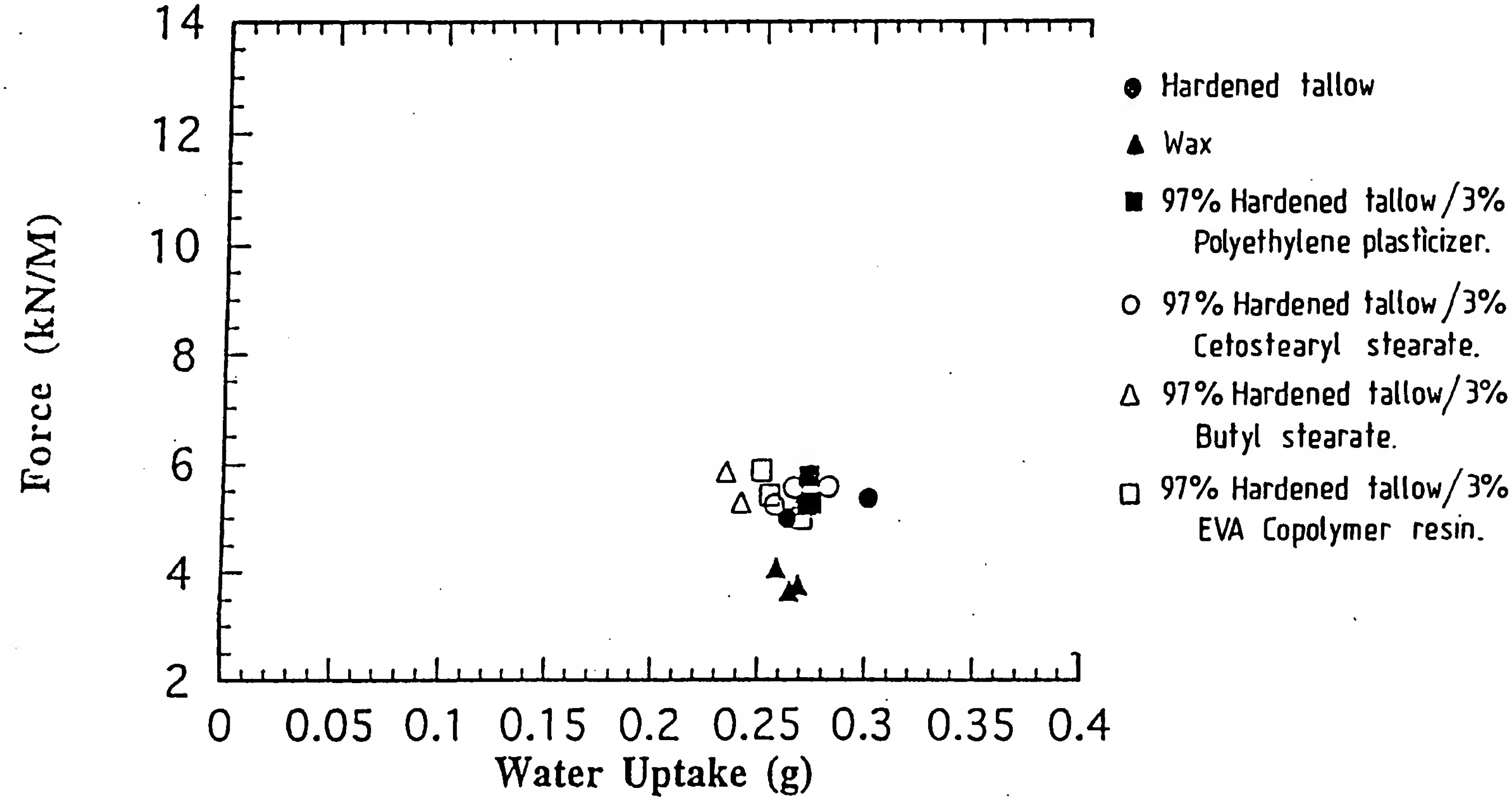


FIG. 8.

Water uptake of 230 liner coated with mixtures of Prifat 9833 and hardened coconut oil (100% w/w pick-up)

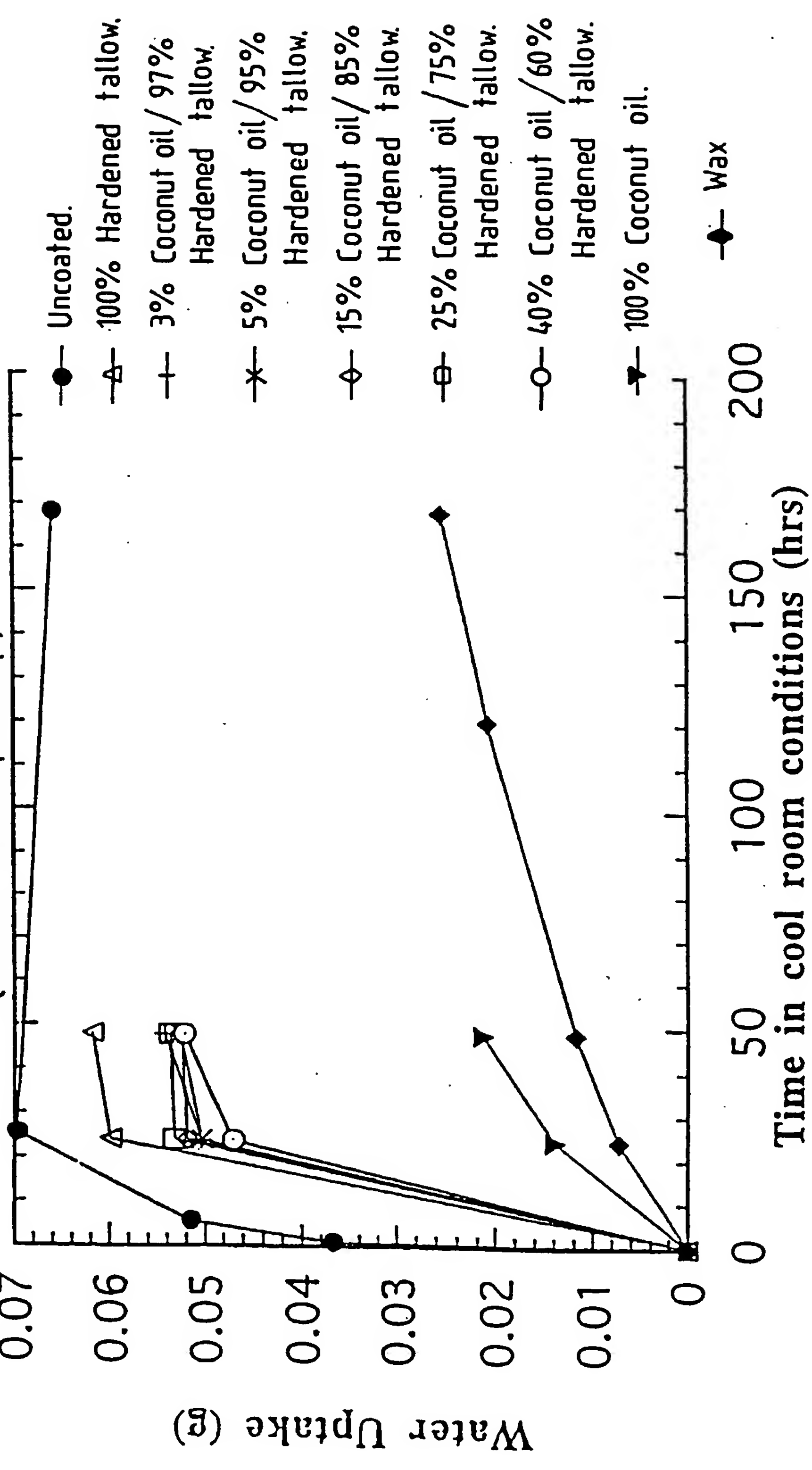


FIG. 9.

Water Uptake of 230 liner coated with mixtures of Prifat 9833 and partially hardened fish oil (100% w/w pick-up)

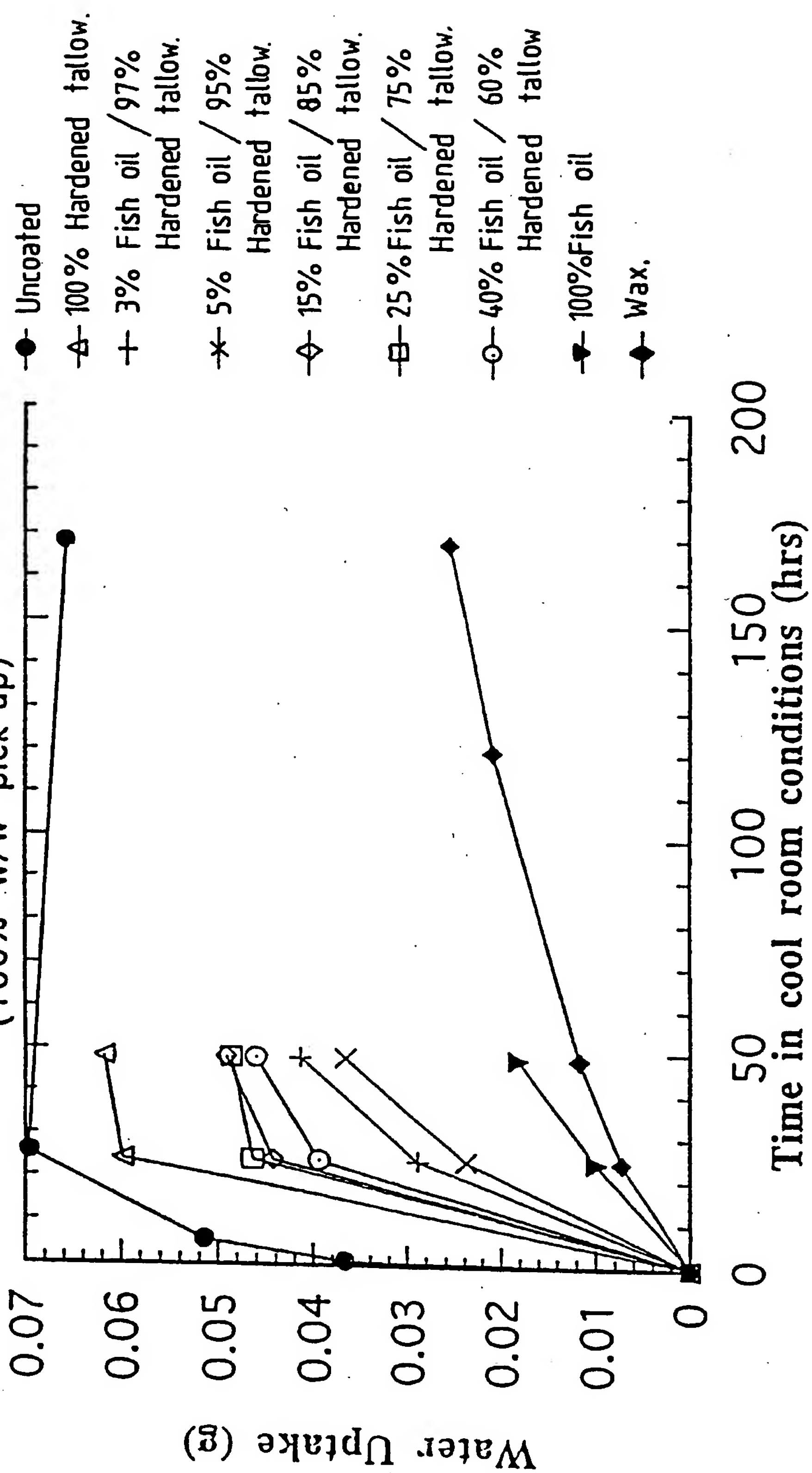
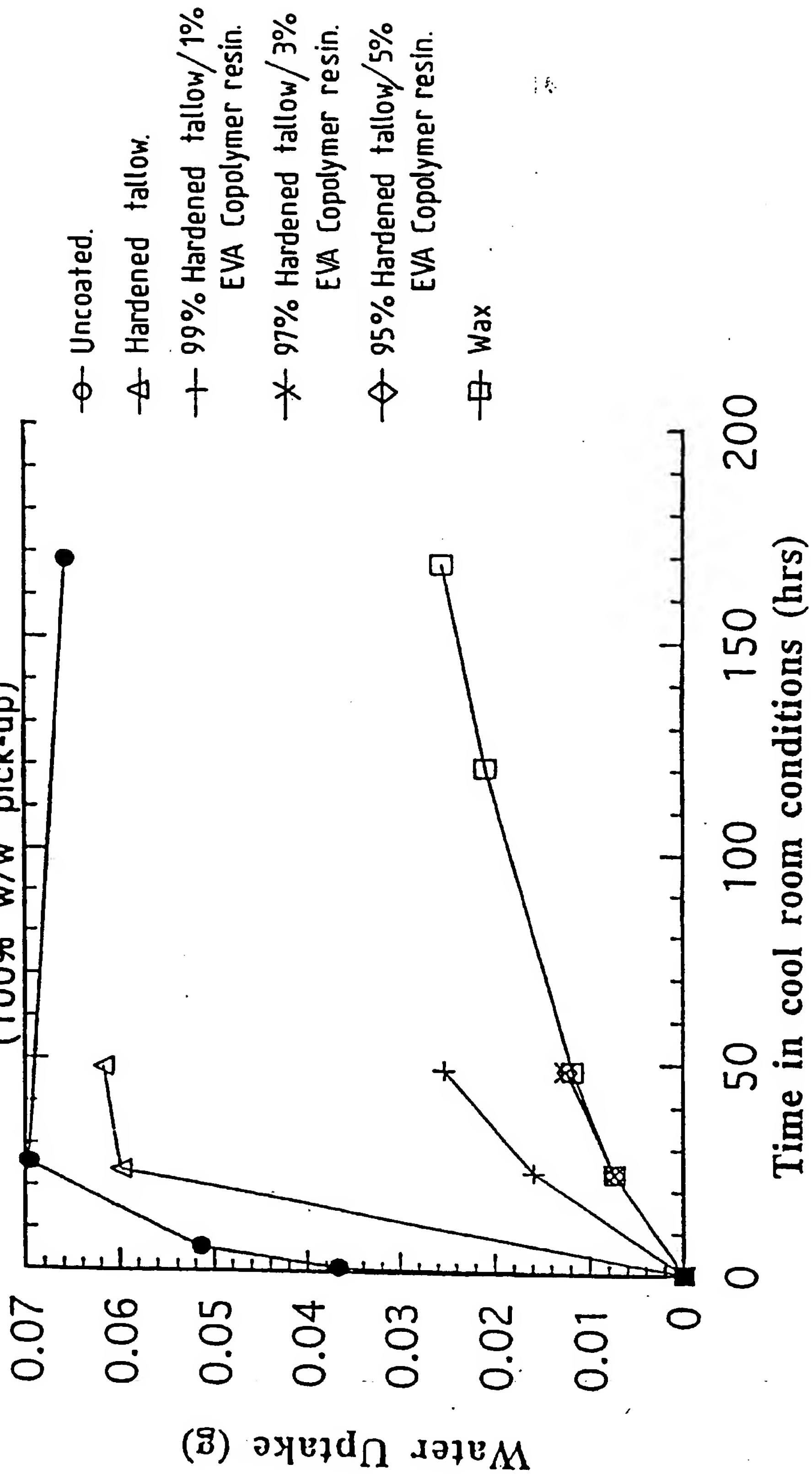


FIG. 10.

Water uptake of 230 liner coated with Prifat 9833 doped with EVA copolymer resin (100% w/w pick-up)



INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 95/00385

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: D21H 21/20 17/02; B65D 65/42

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC D21H 21/20 17/02 3/02 1/24 1/40 19/14; B65D 65/42

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Derwent

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3962509 A (THOMPSON) 8 June 1976. See column 2 lines 63-68, column 4 lines 15-32	1-5, 8, 12-17
Y		18
X	US 4404358 A (BALLERT) 13 September 1983. See column 1 line 34 column 2 line 11	1-3,5,8-9,12,14-15
X	US 2204612 A (MUSHER) 18 June 1940. See column 1 line 34 to column 2 line 6	1-2, 4-7, 13

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 October 1995	16 OCTOBER 1995

Name and mailing address of the ISA/AU	Authorized officer
AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (06) 285 3929	R.P. ALLEN Telephone No.: (06) 283 2134

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 328323 A1 (ROHM AND HAAS COMPANY) 16 August 1989. See page 4 lines 6-11 and lines 48-54; page 5 line 39	1-12,14-18
X	GB 1371977 A (THE B.F.GOODRICH COMPANY) 30 October 1974. See page 1 lines 11-41, page 4 lines 58-89	1-6, 8-12, 14-17
X	Derwent Abstract Accession No. 91-092188/13, Class P73, JP 03-038344 A (HITACHI CHEMICAL KK) 19 February 1991	1-3, 5, 7-8, 12, 14-17
X	Derwent Abstract Accession No. 93-146273/18, Class P73, JP 05-078638 A (GEN SEKIYU KAGAKU KOGYO KK) 30 March 1993	1-3, 5, 7, 8, 12, 14-17
X	Derwent Abstract Accession No. 35457 D/20, Class A82, JP 05-6032550 A (NISSHIN OIL MILLS KK) 02 April 1981	1-3, 5-8, 12, 14-17
Y	Derwent Abstract Accession No. 60725 W/37, Class F09, DT 2457717 A (ANDAX PTY LTD) 04 September 1975	18
A	US 5030388 A (Martino et al) 9 July 1991	

INTERNATIONAL SEARCH REPORT
Information on patent family members

International Application No.
PCT/AU 95/00385

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	3962509	BE	825547	CA	1035640	DE	2502700
		ES	435097	FR	2263084	GB	1444336
		IT	1033177	NL	7502556		
US	4404358	BR	7908924	EP	18995	WO	8001053
EP	328323	AU	29836/89	BR	8900410	CA	1328320
		CN	1035313	DK	641/89	FI	890666
		HK	661/92	NO	890464	NZ	227913
		PT	89684	SG	649/92	ZA	8901012
US	5030388	CA	1296595	US	5011630		

END OF ANNEX